Feb. 20, 1945. C. L. EKSERGIAN ET AL 2,369,726

BRAKE CONTROL DEVICE

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FIG. 1

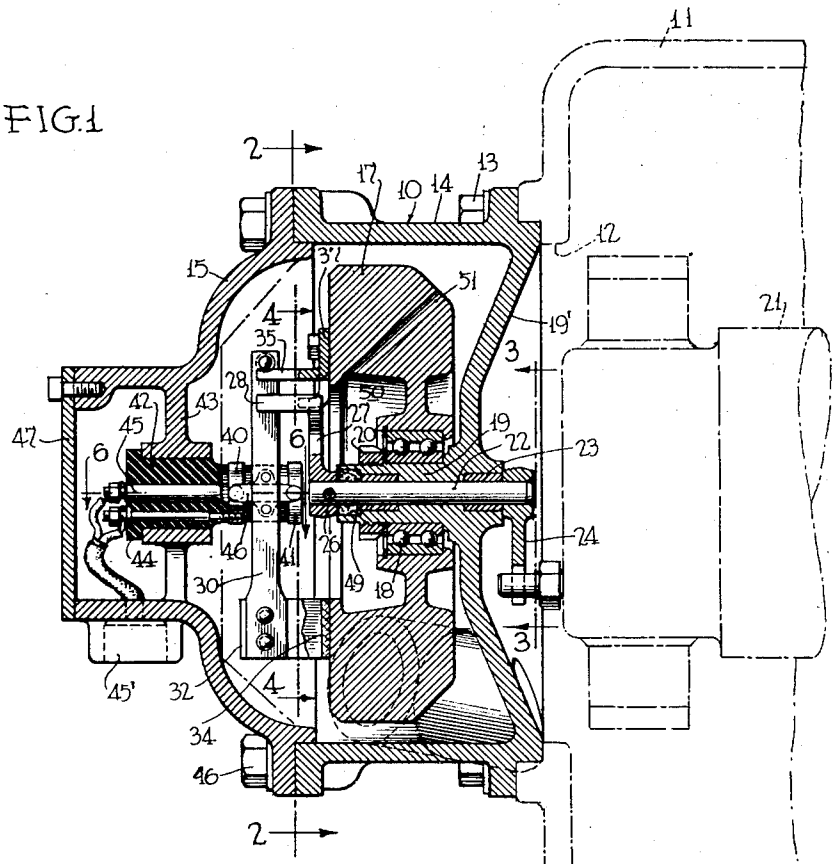
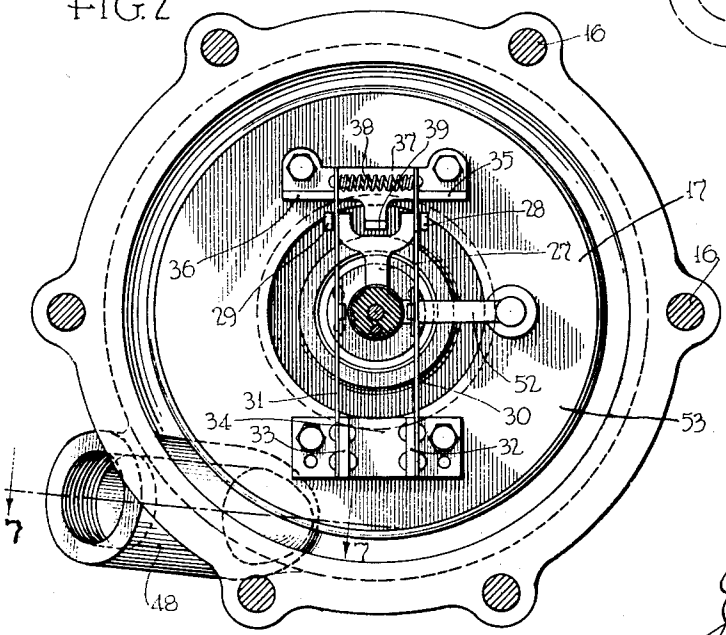


FIG. 2



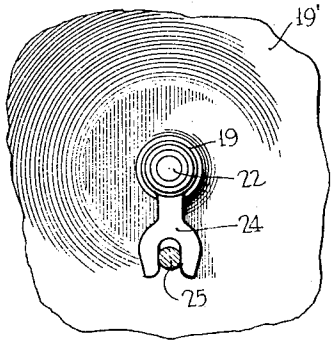


FIG. 3

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FIG.4

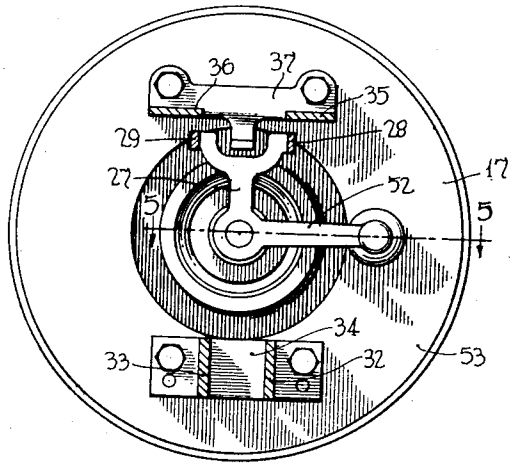
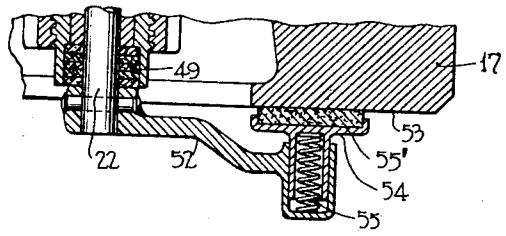


FIG.5



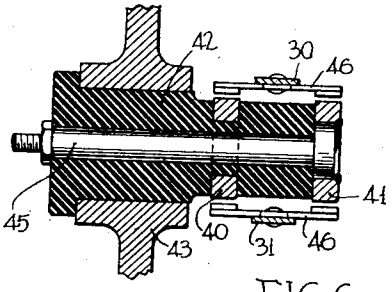


FIG.6

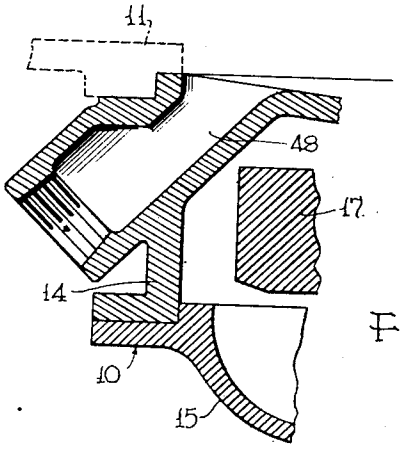
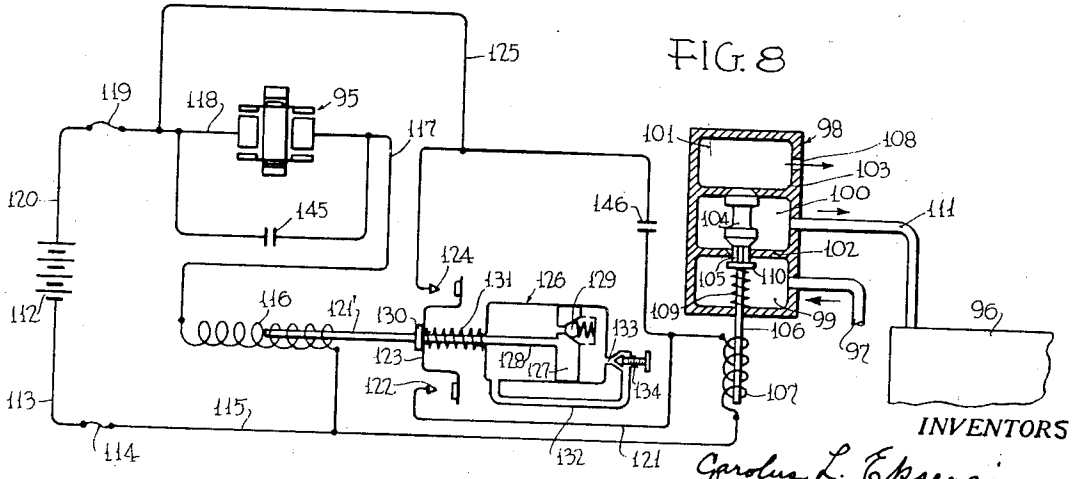


FIG.7

FIG.8



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UNITED STATES PATENT OFFICE

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BRAKE CONTROL DEVICE

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Application May 5, 1943, Serial No. 485,788

6 Claims. (Cl. 200—52)

The invention relates to a wheel protector for railway wheels and particularly to such a device adapted to prevent sliding of the wheels on the tracks due to brake application.

In modern high speed trains, adequate braking becomes highly important to enable the train to be brought to a stop within reasonable distances. It is of no avail, however, to exert powerful braking on the wheels unless the wheels are maintained during the braking in rolling contact with the rails. If the braking force overcomes the rail adhesion the wheel will slip on the rail and if the braking force is not reduced it will rapidly decelerate to a "locked" state in which it slides on the rail. Such sliding on the rail is objectionable for two reasons: First, it wears "flats" on the slid wheel necessitating the removal of the wheel and the grinding and truing thereof, and second, the sliding wheel has less retarding effect on the train than a braked rolling wheel, since it is well known that the coefficient of sliding friction is less than the coefficient of rolling friction.

It is an object of the invention to overcome these difficulties and insure that the braking force never, during running, is allowed to remain on long enough to permit a slipping wheel to reach the sliding stage, but to maintain the braking at a high efficiency by promptly again applying the braking force to the wheel as soon as may be after the wheel has returned to normal speed following slipping thereof.

It is further an object of my invention to provide an instrumentality of this class which is simple in construction, efficient in operation, assured of a long life in use, and one which can be readily applied to the vehicle and manufactured at low cost.

In practice, the device may consist of a suitable valve mechanism inserted in the usual operator-controlled pressure line to the brake cylinder and an automatic control for the operation of said valve to cut off and release pressure to and from the brake cylinder, said control including an inertia governor responsive to excessive acceleration and deceleration, such as takes place on wheel slip, of the wheel being braked. Preferably, one such control device is inserted in each brake cylinder pressure line so that each wheel or at least each axle of the vehicle is protected by a separate device against sliding. With the usual axle having two wheels fixed thereto, it is desirable to associate a control device with each axle.

Other and further objects and advantages and the manner in which they are attained will become apparent from the following detailed description when read in connection with the drawings forming a part of this specification.

In the drawings:

Fig. 1 is a vertical axial sectional view through a preferred form of inertia governor device shown applied to the end of a vehicle axle,

Fig. 2 is a section at right angles to the section of Fig. 1 taken on the line 2—2 of Fig. 1,

Fig. 3 is a fragmentary sectional view taken on the line 3—3 of Fig. 1,

Fig. 4 is a sectional view, the section being taken on the line 4—4 of Fig. 1,

Fig. 5 is a fragmentary sectional view on an enlarged scale taken on the line 5—5 of Fig. 4,

Fig. 6 is a fragmentary sectional view on an enlarged scale taken on the line 6—6 of Fig. 1,

Fig. 7 is a fragmentary sectional view taken on the line 7—7 of Fig. 2, and

Fig. 8 is a diagrammatic view showing one arrangement of an electro-pneumatic system which may be controlled by the governor devices of either Figs. 1 to 7.

In the form of the invention herein illustrated, the inertia governor device together with the electric switch controlled thereby is housed in a unitary casing 10 which may take the place of the usual cover on the end of the axle bearing box 11 and be secured directly to the margin of the opening 12 in a manner to form a tight closure therefor, by the bolts 13.

The casing, for convenience of assembly and disassembly, may comprise two sections 14 and 15 forming a tight joint with each other and secured together by bolts 16. The rotary inertia member 17 is mounted through an anti-friction bearing 18 upon an outwardly projecting boss 19 extending from the inner wall 19' of the casing 10. The outer race of the bearing 18 is secured to the hub of the inertia member between a shoulder at the inner end of the hub and a split ring engaging a groove adjacent the outer end, while the inner race is secured between a shoulder on the inner end of the boss and a nut 20 screwed onto its screw-threaded outer end. The inertia member 17 is arranged to be driven from the axle 21 of the vehicle through a connection which is readily engaged when the casing 10 is assembled, by axial movement, with the axle box 11 and axle 21, and in order to enable the inertia member, at times, to overrun or lag behind the axle, the driving connection includes resilient means.

To enable the resilient drive to be arranged at

the outer face of the inertia member where it is readily accessible by removing the outer section 15 of the casing, a crankshaft 22 is passed through a bore extending concentric with the axle through the inner wall 19' of the casing and the boss 19 projecting therefrom, this shaft being rotatable in bearing bushings as 23 arranged adjacent the opposite ends thereof. At its inner end the shaft has secured to it an arm 24 which is bifurcated to straddle a stud 25 secured in eccentric relation to the end of the axle. At its outer end it has secured to it, as by a pin 26, an arm 27 which is also bifurcated at its outer end and provided with axially extending driving extensions 28 and 29 one on each of the furcations and spaced apart some distance, see Fig. 2. The extensions 28 and 29 straddle a pair of flexible driving members in the form of spaced flexible spring members 30 and 31 arranged along chords approximating the diameter and at equal distances from the opposite sides of the axis of the inertia member.

These spring members are secured as by rivets at one of their adjacent ends to axial extensions 32 and 33, respectively, of a bracket 34 bolted to the outer face of the inertia member. Adjacent their opposite free ends they extend close to the adjacent faces of the driving extensions 28 and 29, respectively, and at these free ends they bear against axially extending abutments 35 and 36, respectively, projecting from a bracket 37 bolted to the outer face of the inertia member 17.

In this invention the flexible spring members 30 and 31 are tensioned by a coil spring 38 arranged between their free ends to hold them against the abutments 35 and 36, respectively. As clearly appears in Fig. 2 the brackets 34 and 37 and members 30 and 31 are arranged in balanced relation about the axis of the inertia member so as to maintain it in balance.

From the foregoing, it will be seen that the inertia member is constantly driven from the axle through a yielding drive. At normal rates of acceleration and deceleration, say not exceeding 5 miles per hour per second, the tension is sufficient to maintain the flexible spring members against the abutments 35 and 36 and the drive is effected with very little deflection thereof, since the engagement of the driving extensions 28 and 29 with the members is very close to the abutments. When the acceleration or deceleration of the axle rises above the normal, say to 10 miles per hour per second, the resistance of the flexible spring member then doing the driving and the tension of the coil spring 38 is overcome so that the flexible spring member is moved toward a fixed abutment 39 projecting axially from bracket 37 between the springs 30 and 31. When such movement occurs a switch in an electric circuit is closed and held closed as long as such excessive acceleration or deceleration persists. When the acceleration or deceleration again reaches the normal rate, i. e. the rate of travel of the vehicle, the tension of the coil spring 38 under compression restores the parts to the position shown in Fig. 2.

The switch controlled by the inertia member may comprise a spaced pair of collector rings 40 and 41 mounted on a plug 42 of insulating material, which plug has its outer end rigidly mounted in the hub of a spider 43 supported from the wall of the outer casing section 15. The inner reduced end of this plug extends between the members 30 and 31 substantially in axial alignment with the axis of the inertia member and carries the collector rings axially on opposite sides of said members. The collector rings are connected to binding posts 44 and 45 which in turn are connected to wires in the circuit to be controlled by the switch which wires may be extended through the wall of the casing to a usual form of attachment socket indicated at 45'. Opposite the rings 40 and 41 each of the spring members 30 and 31 carries a bridging contact 46 secured to the member intermediate its ends, suitably insulated therefrom and carrying a pair of contact buttons, one at each end thereof, but normally spaced from the rings. When, due to abnormal acceleration or deceleration, one of the members is deflected toward the stop abutment 39, the associated bridging member contact buttons are brought into engagement with the collector rings to close the switch, and the switch will be held closed until the parts return to the position of Fig. 2, following a return to normal acceleration or deceleration.

To permit examination of the switch and drive at any time, a removable cover 47 is provided to close the outer reduced end of the casing 10. When the cover is removed, direct access is had to the binding posts and to the inside of the spider 43 through the openings between the spokes thereof. To permit filling of the axle box with oil to the required level to oil the bearings of the axle, a charging port 48 may be provided in the casing part 14, see Figs. 1, 2, 7, this port opening at its inner end into the bearing box 11 and at its outer end being provided with a screw thread to receive a closing plug, not shown. The bottom of the outer end of this port is preferably arranged at the level at which it is desired to hold the oil in the bearing box. By placing this port in the casing, it is unnecessary to provide a separate filler port in the axle box.

To prevent leakage of oil from the axle box into the casing 10 a suitable packing, as 49, is provided between the shaft 22 and the boss 19. Even if there should be slight leakage of oil past the packing, it would be thrown out centrifugally into an inwardly facing annular channel 50 having an inclined bottom and discharged through an opening 51 extending from the lowest portion of said channel to the periphery of the inertia member, from whence it would collect by gravity at the bottom of the casing.

To prevent undesired surges of the inertia member, a damper is preferably associated therewith. Such damper may comprise an arm 52 extending at substantially right angles from the arm 27 and preferably integral therewith, this arm 52 having at its free end a socket arranged at right angles to the flat outer face 53 of the inertia member and carrying for telescoping movement with said socket a brake shoe 54 carrying on its face engaging the face 53 a suitable friction material 55'. The shoe is pressed into braking engagement by a spring 55 housed within the telescoping parts of the arm and shoe.

The operation of the inertia controlled switch shown in Figs. 1 to 7, inclusive, will now be described. While the axle is rotating, the inertia member 17 is driven through the shaft 22 and one of the axially extending driving arms 28 or 29, engaging the spring member 30 or 31 adjacent thereto. Obviously, the inertia member is driven by one or the other driving arm 28 or 29 tending to flex the associated yieldable spring member 30 or 31. This, in turn, more or less compresses the coil spring 38, causing the other spring member to bear against the associated abutment 35 or 36,

transmitting rotation to the inertia member. While the wheels and axle are decelerating at a normal rate during braking, the tension of the coil spring **38** is sufficient to prevent relative rotary movement between the inertia member and the shaft **22**, rotating at the speed of the axle, sufficient to flex either of the spring members and close the switch by engagement of the bridging contact with the collector rings **40**, **41**. Undesired surges of the inertia member are prevented by the damping brake **52** to **55**. If, however, a wheel begins to slip, the axle at once begins to decelerate very rapidly and almost immediately after the start of slipping attains a deceleration, say double the normal deceleration. The inertia member under this abnormal deceleration overruns the axle speed, flexes one of the members **30**, **31**, against the pressure of the coil spring **38**, and moves its associated bridging contact into contact with the collector rings to close the switch. The switch will be held closed until the deceleration again drops to a rate near the normal rate, say below 10 miles per hour per second, when the spring tension will return the parts to the position in Fig. 2 with the switch open.

With the arrangement of switch members shown, little wear of the switch contacts results because they are in engagement only at intervals of wheel slip. At the same time, during such intervals the contacts are engaged with the collector rings and wipe over them to maintain them clean and free from accumulation of dirt or rust. Thus they are always maintained in good condition not withstanding the fact that they engage only in case of wheel slipping.

In Fig. 8 is shown a diagram of an electro-pneumatic brake control system which may be employed in conjunction with the present invention for controlling the brakes associated with a wheel and axle for preventing wheel slide. In this diagram, the inertia-responsive switch is designated by **95**, the brake cylinder by **96**, the operator-controlled pipe line for supplying fluid under pressure to the brake cylinder by **97** and the automatically controlled valve device controlling the admission to and release of fluid from the brake cylinder by **98**. The condition of this valve is controlled by the control circuit or circuits responsive to the inertia switch **95**. The valve **98** may comprise three chambers **99**, **100** and **101** separated by ported partitions **102**, **103**. A double-acting valve **104** is arranged in the chamber **100** and has a fluted stem **105** guiding it through the port in partition **102**, the fluted stem being continued by a stem **106** of reduced section through an opening in the end wall of the valve casing, this outer projecting portion of the stem forming an armature operable by a magnet coil **107**.

The valve is normally held in the position shown closing the port in the partition **103**, which in turn leads to the exhaust port **108**, and opening the port through the partition **102**, by a spring **109** surrounding the valve stem and bearing at one end against a shoulder **110** on the stem and at the other end against the adjacent end wall of the valve casing. In this position communication is established between the operator-controlled supply pipe through the pipe **111** connecting the valve chamber **100** to the brake cylinder. While the valve is in this position, the brake cylinder pressure is thus under the control of the operator and can be varied at will.

When the wheel braked by the pressure in the brake cylinder starts to slip the switch **95** is closed immediately, since the wheel starts to decelerate rapidly as soon as slipping is instigated. This closes a primary circuit from battery **112** or other source of energy, through lead **113**, fuse **114**, lead **115**, magnet coil **116**, lead **117**, switch contacts of switch **95**, lead **118**, fuse **119**, and lead **120** back to the other side of the battery. The closing of this circuit immediately causes the armature **121'** of a closing switch in a relay circuit to be moved to the left, Fig. 12, closing the relay circuit for energizing the magnet valve **107** to operate the valve **104** to its other or lower position, in which it cuts off the supply of fluid pressure to the brake cylinder and opens the brake cylinder to exhaust. This relay circuit comprises battery **112**, lead **113**, fuse **114**, lead **115**, magnet coil **107**, lead **121**, switch point **122**, bridging contact **123**, switch point **124**, lead **125**, fuse **119**, and lead **120** back to the other side of the battery. Suitable condensers as **145** and **146** may be connected across the switch terminals to minimize arcing.

As soon as the valve is operated to the lower position the pressure drops rapidly in the brake cylinder releasing the brakes and allowing the wheel to accelerate back to normal. To prevent opening of the relay circuit at the time when the wheel ceases to decelerate and again starts to accelerate, at which time the inertia-responsive switch **95** in the primary circuit is open, a time delay device is associated with the relay circuit to hold the switch **122**, **123**, **124** closed for a predetermined time period after the opening of the primary circuit. When the wheel has started to accelerate during slipping, the inertia member at a certain point in the acceleration lags behind the wheel and closes the primary circuit again through the inertia-controlled switch **95** and holds it closed until the wheel acceleration has again come back to normal rate corresponding to the deceleration rate of the train as a whole. Not until the relay circuit is allowed to be opened by the time delay device (which is again actuated to its starting position upon the second closure of the primary circuit and held in this position while the primary circuit is held closed, and is finally allowed to open the relay circuit only after the time for which it has been set has elapsed following the opening of the primary circuit as the wheel returns to its normal rate) is the valve returned to the position shown in Fig. 12 and the pressure again allowed to build up in the brake cylinder to apply the brakes.

In the diagram the time delay device is shown as comprising a dash-pot **126**, the piston **127** and rod **128** of which is connected to the armature **121'**. The piston **127** is provided with a one-way valve **129** permitting the fluid in the dash-pot to pass rapidly without hindrance from left to right of the piston when the coil **116** is energized, to substantially instantly close the switch **122**, **123**, **124**. The switch member **123** has a lost motion connection with the piston rod **128** and is normally held against a shoulder **130** on the rod by a light spring **131**. This lost motion is provided to allow the piston **127** of the dash-pot to move to the right the required distance before the shoulder **130** strikes the contact member **123** and opens the switch. The rate of return of the piston **127** to the right is controlled by a by-pass **132** the orifice **133** of which can be adjusted by an adjustable tapered plug **134**.

While a specific dash-pot delay device has been described, it will be understood that other known types of delay action devices could be used. By setting the dash-pot device to delay the opening

of the relay circuit for a period greater than the period during which the primary circuit is open when the wheel goes from deceleration to acceleration during slipping, which has been found to be a very short period, of the order of a fourth of a second, ample time is assured, before the full reapplication of the brakes, to allow the wheel to return to normal speed, and yet the time can be so controlled that substantially no braking efficiency is lost except that lost during the short time in which the wheel, while slipping, is decelerating and again accelerating back to normal, which has been found of the order of one second or even less. If, after reapplication of the brakes following wheel slipping, the track conditions should be such as to reduce rail adhesion, the wheel may again reach a slipping condition and in such event, the cycle to bring it back to normal before it actually slides on the track would be repeated. Of course, the operator could prevent such recurrence if he observed the track conditions and reduce the pressure in the control pipe 97.

It should be understood that the control system described does not form a part of the present invention, and that a description of it is included herein only to illustrate the complete operation of the present invention. Reference should be made to the copending application for Brake control means, Serial No. 415,518, filed October 18, 1941, in which certain features of construction herein described are claimed. It will be apparent that the present invention can be variously modified and adapted within the scope of the appended claims.

What is claimed is:

1. An inertia device for registering the rotary condition of a rotatable member comprising a rotary inertia element, a flexible driving connection between said rotatable member and said element including spaced flexible spring members, each member being secured at one end to said inertia element and extending across the face thereof on opposite sides of the axis thereof, spaced abutments on said inertia element adjacent the free ends of said members to limit the outwardly flexing movement of each member, spring means biasing each member toward the associated abutment, means driven by said rotatable member and adapted to flex one of said spring members against the pressure of said spring means to press the other member against its associated abutment and rotate said inertia element, and electrical switch means adapted to be controlled by a predetermined degree of flexing movement of either of said spring members.

2. An inertia device for registering the rotary condition of a rotatable member comprising a rotary inertia element, a flexible driving connection between said rotatable member and said element including spaced flexible spring members, each member being secured at one end to said inertia element and extending across the face thereof on opposite sides of the axis thereof, spaced abutments on said inertia element adjacent the free ends of said members to limit the outwardly flexing movement of each member, a coil spring interposed between the free ends of said flexible members to bias each member toward the associated abutment, means driven by said rotatable member and adapted to flex one of said spring members against the pressure of said coil spring to press the other member against its associated abutment and rotate said inertia element, and electrical switch means adapted to be controlled by a predetermined degree of flexing movement of either of said spring members.

3. An inertia device for registering the rotary condition of a rotatable member comprising a rotary inertia element, a flexible driving connection between said rotatable member and said element including a pair of parallel spaced flexible members secured at their adjacent ends to said inertia element and extending across the face thereof on opposite sides of the axis thereof, spaced abutments on said inertia element adjacent the free ends of said members to limit the outwardly flexing movement of each member, a coil spring interposed between the free ends of said flexible members to bias each member toward the associated abutment, means driven by said rotatable member and adapted to flex one or the other of said flexible members against the pressure of said coil spring to press the other member against its associated abutment and rotate said inertia element, and electrical switch means adapted to be controlled by a predetermined degree of flexing movement of either of said flexible members.

4. An inertia device for registering the rotary condition of a rotatable member comprising a rotary inertia element, a flexible driving connection between said rotatable member and said element including spaced flexible spring members, each member being secured at one end to said inertia element and extending across the face thereof on opposite sides of the axis thereof, spaced abutments on said inertia element adjacent the free ends of said members to limit the outward flexible movement of each member, spring means biasing each member toward the associated abutment, means driven by said rotatable member and adapted to flex one of said spring members against the pressure of said spring means to press the other member against its associated abutment and rotate said inertia element, and control means adapted to be operated by a predetermined degree of flexing movement of either of said spring members.

5. An inertia device for registering the rotary condition of a rotatable member comprising a rotary inertia element, a flexible driving connection between said rotatable member and said element including spaced movable members, each movable member being secured at one end to said inertia element and said movable members extending across the face of said element on opposite sides of the axis thereof, spaced abutments on said inertia element adjacent the free ends of said movable members to limit the outward movement of each member, means biasing each movable member toward its associated abutment, and means driven by said rotatable member and adapted to move one of said movable members against the action of said biasing means to press the other against its associated abutment and rotate said inertia element, and control means adapted to be operated by a predetermined degree of movement of either of said movable members.

6. An inertia device for registering the rotary condition of a rotatable member comprising a rotary inertia element, and a flexible driving connection between said rotatable member and said element including spaced movable members, each movable member being secured at one end to one of said rotatable member and said inertia element and said movable members extending transversely, and on opposite sides of the axis of, said one of said rotatable member and said in-

ertia element, spaced abutments on said one of said rotatable member and said inertia element adjacent the free ends of said movable members to limit the outward movement of each member, means biasing each movable member toward its associated abutment, and means driven by the other of said rotatable member and said inertia element to move one of said movable members against the action of said biasing means to press the other against its associated abutment and rotate said inertia element, and control means adapted to be operated by a predetermined degree of movement of either of said movable members.

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